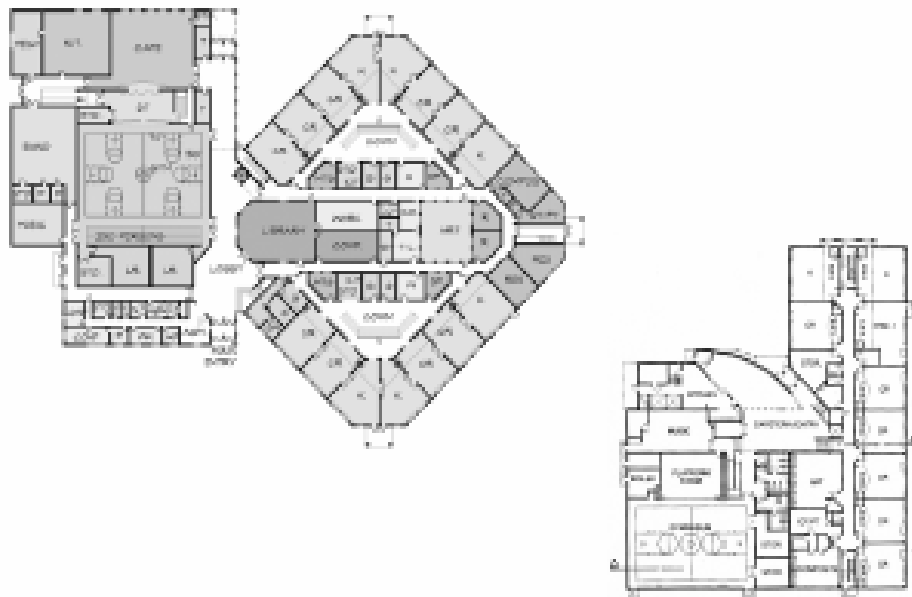


AN ANALYSIS OF CONSTRUCTION OF SMALL SCHOOLS VS. LARGER SCHOOLS



**PREPARED BY AN
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A BRIEF STUDY OF SQUARE FOOTAGE PER STUDENT & OPERATIONAL COSTS



**PRESENTED TO THE
STATE OF MAINE
STATE BOARD OF EDUCATION**

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Title page drawing by Mark Brown

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INTRODUCTION

The Chairperson of the State Board of Education's Construction Committee, Ellie Multer, requested that Scott Brown, Director of the Division of School Facilities, put together a small group to look at the relationship between school enrollments and the efficiency of a building in terms of square feet per student. She further requested that the group consider whether there is a savings associated with the construction of a larger consolidated school as compared to two or more smaller schools.

The Division Director, two architects, and two consultants met and assembled the information contained in this brief report. Paul Johnson, Consultant, researched national data on school sizes and enrollments. He also plotted recently constructed schools in Maine.

Dan Cecil, an architect from Harriman Associates, had recently conducted a study for a school system in which he compared the costs of building and operating a consolidated school compared to building and operating two smaller schools in the same school district.

Lyndon Keck, an architect from the Portland Design Team, plotted school projects that compared student enrollments with square feet per student.

The results of these efforts follow, and they are analyzed in the Executive Summary.

EXECUTIVE SUMMARY

The ad hoc committee came to the following conclusions after reviewing the information presented in this report.

- From the Dan Cecil study a consolidated school can serve the same student population and offer the same curriculum with less square footage and thus a reduced cost. This primarily is the result of space duplications in the two-school scenario.
- The Dan Cecil study also compared operating costs between the two options. There were significant savings in both operational and personnel costs. When projected over a 40-year life cycle, the savings per student approached \$3,500.00.
- From the Lyndon Keck study it is evident that as a school grows smaller in terms of enrollment, the square feet per student increases. This translates into a greater cost per student for smaller school units.
- The Department of Education data confirms from both the national and a state-wide basis that both the Cecil analysis and the Keck analysis hold true.

With limited State resources available for capital construction, encouraging consolidation in order to build larger schools is in the best interest of the state's expenditure for capital construction projects.

HARRIMAN ASSOCIATES' NARRATIVE

Litchfield, New Hampshire, Elementary Schools Study Goals

The school department wanted to know if there was any difference in construction costs and operations and maintenance costs in building two smaller elementary schools vs. one larger school of the same total student population. The total population involved consisted of 1000 students, grades 1-5, and 40 Pre-kindergarten students. Both options were for new school buildings. The result of the study would direct which option they would take to referendum in March of 2006. The district wanted to bring to the voters the most cost effective, long-term solution. The building committee responsible for managing the study was chaired by a school board member and consisted of 16 people including additional school board members, two selectmen, a budget committee member, parents, elementary school administrators, teachers and staff, and the Superintendent and Business Manager. The study was conducted over a five-month period.

Space Allocation Workbooks

The school department, elementary school administrators, and the architect created space allocation workbooks for both the two school and the one-school scenarios to determine how large each building would be. The architects conducted a full programming process, interviewing all teachers, staff, and administrators to catalog their educational programs and determine their space requirements. There were several rounds of review of the workbooks with the stakeholders and the building committee to insure that the square footages required were as efficient and comprehensive as possible. The building committee mandated that in either scenario, the students would receive the same level of educational programs with the same student/teacher ratio.

The Two School Scenario

In this scenario, one school would house 640 students grades Pre-K through 3, and the second school would house 400 students, grades 4 and 5. These schools would be on separate sites owned by the school department within the Town.

The One School Scenario

In this scenario, one consolidated school was planned to house all 1040 students, grades Pre-K through 5. In the attached study data, one can see that the single school housed the same number of students in 23,058 square feet less space. The program offerings were identical as mandated by the building committee.

Total Project Cost Savings

On the construction side of the equation, the reduction of square footage resulted in a reduction of total project costs of \$3,458,700, assuming \$150/square foot. This is money that would have been bonded over 20 years, greatly increasing the actual savings. If the \$/square foot number was higher than \$150, then the savings would be correspondingly higher.

Annual Operations Savings

The architects reviewed the school district's actual operations budgets for their existing school in the following categories - oil, power, water, sewer, gas, data, phone, trash pickup, and snow removal. The district is currently spending about \$1.84/square foot/year for these operations costs. For the one school scenario this represents an annual savings of \$42,426.

Annual Personnel Savings

To catalog any differences in staffing resulting from consolidating two schools, the school administrators conducted a detailed exercise to verify staff requirements room-by-room and program-by-program in each scenario. They looked at administration, teaching and staff positions and found reductions in each for the one school scenario. The annual personnel savings were \$117,456.

Summary of Total Savings for the One School Scenario

These potential savings have to be reviewed in the context of the 40-year life of the school building to fully appreciate their magnitude:

- **Total Project Cost Savings – The \$3,458,700 initial total project cost savings would roughly double in value over the course of the 20 year bond depending on the interest rates.**
- Annual Operations Savings – Assuming that these annual savings would remain constant over the 40-year life cycle of the school, the total savings would be approximately \$1,697,000. It is likely, however, that these operations savings would increase every year due to inflation, resulting in even greater overall savings.
- Annual Personnel Savings – Likewise at current salary and bonus levels, the personnel savings over the 40-year life cycle of the school would be approximately \$4,698,200. It is also likely that these personnel savings would increase every year due to inflation, resulting in even greater overall savings.

Cost/Student Savings

Another benchmark used to compare school construction projects is the cost per student. In this study the district would save \$3,479/student in the first year by going to a one-school scenario.

Area Reduction/Student

The single school option saves the school district 22.1 square feet/student. This is reflected in the operations costs above.

Summary of Where the Area Reductions Occurred

In the attached chart, the architects cataloged the actual differences in the space allocation workbooks for the two schools vs. one-school scenarios. There were no savings in the number of regular and Pre-K, art and music classrooms because the mandated student/teacher ratios applied to all schemes. Either way you need a total of 50 classrooms plus 2 art and 2 music rooms for 1040 students. There were minor reductions in the special education and library spaces required.

The big savings came in the ‘core spaces’ of the gymnasiums, administrative spaces, cafeterias, kitchens, and custodial spaces. The two-school scenario requires two gyms and the one school scenario requires only one gym for the same number of students. There are similar reductions in the other core spaces. A kitchen, for example, has to be a certain size to serve 400 students but it can handle many more meals per day before needing to add additional equipment and square footage. The area of the 1040 student kitchen grew by only 143% over the area of the 400-student kitchen, although the student population grew by 260%.

Conclusion

The space allocation workbooks for the three buildings were assembled objectively in an actual programming process leading to a referendum. Likewise, the operations and personnel costs were based on the school department’s actual numbers. Therefore, it is likely that these types of area and cost reductions would be replicated in any school consolidation project with a constant number of students involved for both the one and the two school options.

Litchfield, New Hampshire, Elementary School Comparison

Project No. 04147

May 17, 2005 - Rev. June 16, 2005

A. Two School Scenario

New Pre K - Grade 3:

(600 students + 40 pre K) 88,942 sf

New grades 4-5

(400 students) 66,780 sf

Total 155,722 sf

B. One School Scenario

New Pre K - Grade 5:

(1000 students + 40 pre K) 132,664 sf

Difference 23,058 sf net reduction from
building one
consolidated school

C. Total project cost savings: 23,058 sf x \$150/sf = \$3,458,700

D. Annual operations savings: 23,058 sf x \$1.84/sf/yr = \$42,426.72
(Oil, power, water, sewer, gas, data, phone, trash pickup, snow removal)

E. Personnel savings - Annual salaries and benefits

2 schools \$1,926,912.90

1 school 1,809,456.79

\$ 117,456.11 net savings in
personnel costs

F. Therefore, the approximate net savings for one consolidated school for the first year is:

Total project budget \$ 3,458,700.00

Operations savings/year 42,427.00

Personnel savings/year 117,456.00

Total \$ 3,618,583.00

Note that the operations and personnel savings would continue every year for the 40 year life of the building.

G. Cost/student savings:

\$3,618,583/1040 students = \$ 3,479 per student

H. Area reduction/student:

Two school scenario:

155,722 sf / 1040 students = 149.7 sf/student

One consolidated school scenario:

132,664 sf / 1040 students = 127.6 sf/student

Difference 22.1 sf/student

Litchfield, New Hampshire, Elementary School Comparison

Project No. 04147

May 17, 2005

Typical Rooms	Two Schools		One School	Reduction for One School
	400 students	640 students	1040 students	
Regular classrooms	18 x 900	30 x 900	48 x 900	0
Pre-K	n/a	2 x 1,000	2 x 1,000	0
Art	1 x 1,050	1 x 1,050	2 x 1,050	0
Music	1 x 1,000	1 x 1,000	2 x 1,000	0
Library	1 x 2,850	1 x 3,450	1 x 5,950	-350
Special education	1 x 4,395	1 x 5,625	1 x 9,665	-355
Gym/PE/storage	1 x 8,845	1 x 9,120	1 x 10,950	-7,015
Admin/Guidance Nurse/Faculty	1 x 5,535	1 x 5,785	1 x 7,325	-3,995
Cafeteria	1 x 3,000	1 x 3,200	1 x 4,860	-1,340
Kitchen	1 x 1,650	1 x 1,800	1 x 2,370	-1,080
Custodial/storage	1 x 2,325	1 x 2,400	1 x 2,450	-2,275
				-16,410 sf
				(1.4)
				-22,974 sf

PORTLAND DESIGN TEAM NARRATIVE

Small Schools vs. Large Schools Square Footage Analysis:

PDT Architects has designed over twenty-three elementary schools in the last eighteen years in the State of Maine. School sizes have ranged from 150 students to 950 students. These schools have included traditional K-6, K-5, K-2 and K-3 primary schools, as well as 3-5 and 4-5 intermediate elementary schools.

PDT has noticed a consistent pattern over the years showing that smaller schools require more square feet per student than larger schools. This intuitively makes sense because as school populations get smaller, many areas of the school do not get proportionately smaller in keeping with the reduced population. Obvious examples are hallway widths and handicap toilets that have minimum width requirements as mandated by building codes. Kitchens, boiler rooms, principal's offices, resource rooms and Special Education rooms do not fall on the same direct proportional sliding scale as the number of classrooms a building might have based on differing school populations.

This study focused on three school studies that have been prepared over the last fifteen years for clients that specifically compared building programs for small schools versus larger consolidated schools.

The first of those studies was a study prepared for the Scarborough Primary School that addressed K-3 populations and was done in 1990.

The second study was a study for K-5 elementary schools for Old Town, Maine in 2001. This study compared two elementary schools at 275 students each versus one consolidated school at 550 students.

The third study was done for the Augusta School Department in 2005. It looked at comparing three elementary schools, each at 363 students, versus four elementary schools with populations that range between 245 students to 460 students.

Finding #1:
(see Table One)

The Scarborough Primary School Study found that building a single consolidated school for 630 students resulted in a building that had 25 s.f. per student less than if three smaller schools were built.

The Old Town Study found that building one consolidated school of 550 students versus two schools at 275 resulted in a savings of 15.5 s.f. per student.

The Augusta Elementary School Study found that building three schools, each at 363 students, resulted in a savings of 12 s.f. per student versus smaller schools with a population of between 245 and 313 students.

Finding #2:
(see Table Two)

PDT took the data from the three independent school studies mentioned above and added two additional schools, one for a 950 pupil K-3 primary school which was built at 94 s.f. per student and another for a 200 pupil K-1 primary school which required 175 s.f. per student. This resulted in a study “population” involving fourteen schools with a broad range of populations from 200 students to 950 students. These schools were plotted as number of students against s.f. per student.

The resulting curve shows quite dramatically that schools smaller than 500 students start to require more than 125 s.f. per student.

Schools smaller than 375 students require 130 s.f. per student.

Schools with 250 students require approximately 140 s.f. per student and schools with 200 or fewer students require more than 150 s.f. per student.

The major conclusion from this plotting shows that efficiency, in terms of square feet per student, falls off dramatically at about 250 students. It clearly shows that a school with 500 or more students can have individual spaces that meet minimum space requirements and still be built within 125 s.f. per student.

Conclusion:

This study only looked at elementary schools.

Both Table One and Table Two resulted in data that shows that larger schools require less square footage per student than smaller schools.

It appears that schools with population of 450-500 are the point at which smaller schools require more space per student.

Elementary schools smaller than 250 students require dramatically more space per student with 200 pupil schools needing 150 s.f. or more.

TABLE ONE

SMALL VS. LARGE SCHOOL STUDY

June 1, 2005

1 Old Town Study

School Name		# Students	SF/Student	Average SF/Student	Additional Required SF
One Consolidated School K-5		550	125 sf	125 sf	
Two Schools	K-2	275	131 sf	140.5 sf	15.5
	3-5	275	150 sf		

2 Scarborough Primary Schools

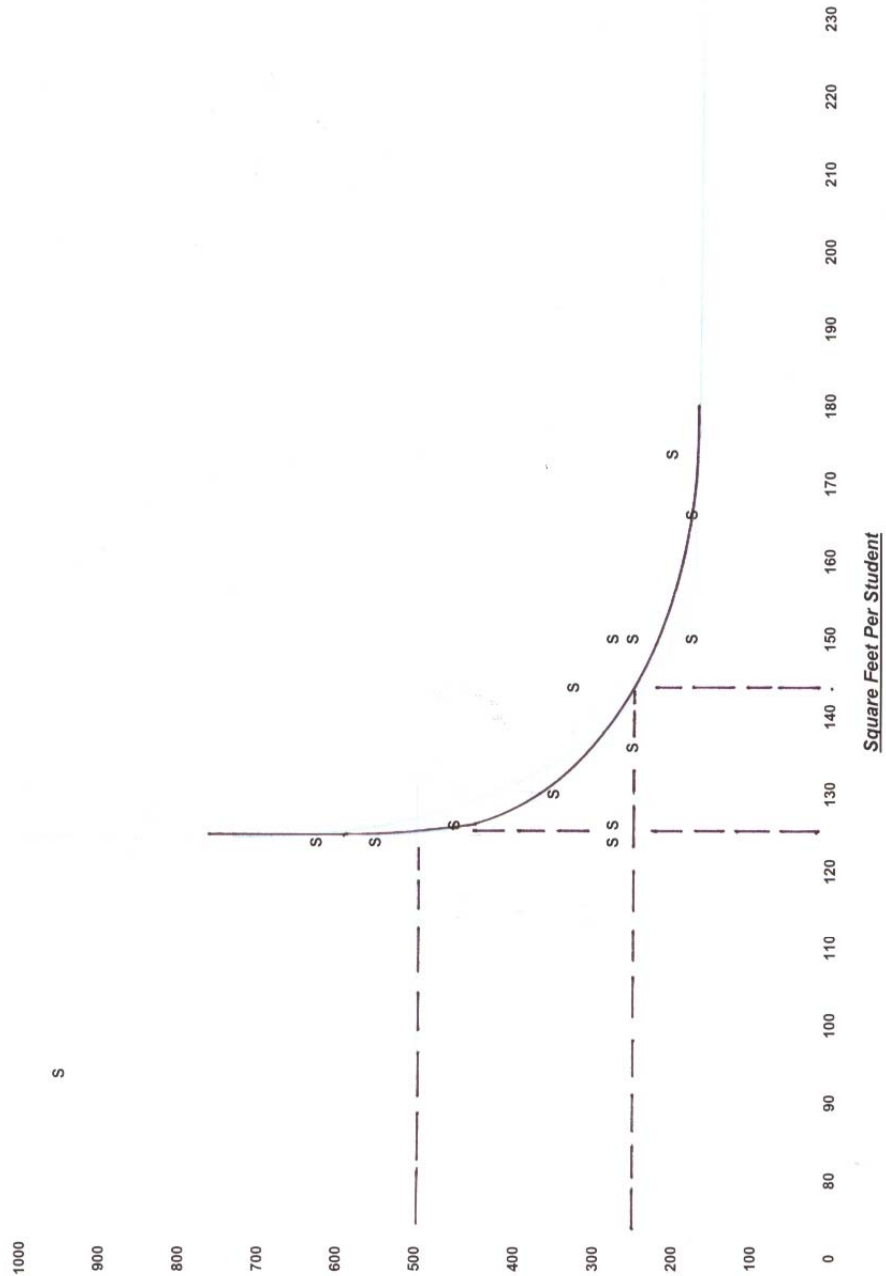
Three Schools					
SPB	K-2	270	128 sf	150 sf	25
SPH	K-2	180	150 sf		
S8C	K-2	180	172 sf		
One School	K-2	630	125 sf		

3 Augusta Elementary Schools

Farrington	K-6	460	125 sf	125 sf	
Gilbert	K-6	313	144 sf	142 sf	12
Hussey	K-6	245	135 sf		
Lincoln	K-6	251	147 sf		
Three Schools @ 363	K-5	363	130 sf	130 sf	

TABLE 2
School Size Plotted Against Population
 14 PDT ELEMENTARY SCHOOLS

PDT Architects
 June 16 2005
of Students



DEPARTMENT OF EDUCATION NARRATIVE

How Recently Built Maine Schools Compare in Number of Students Per School and Square Feet Per Student With Recently Built Schools Nationwide.

The first three charts, one each for elementary, middle, and high schools, show recently built Maine schools with information on the schools' enrollments and square footage per student. The charts also plot the same information using the median for small and large schools recently built nationwide. The national information comes from the February 2004 issue of "School Planning & Management" and is based on the construction of 281 elementary, 111 middle, and 101 high schools.

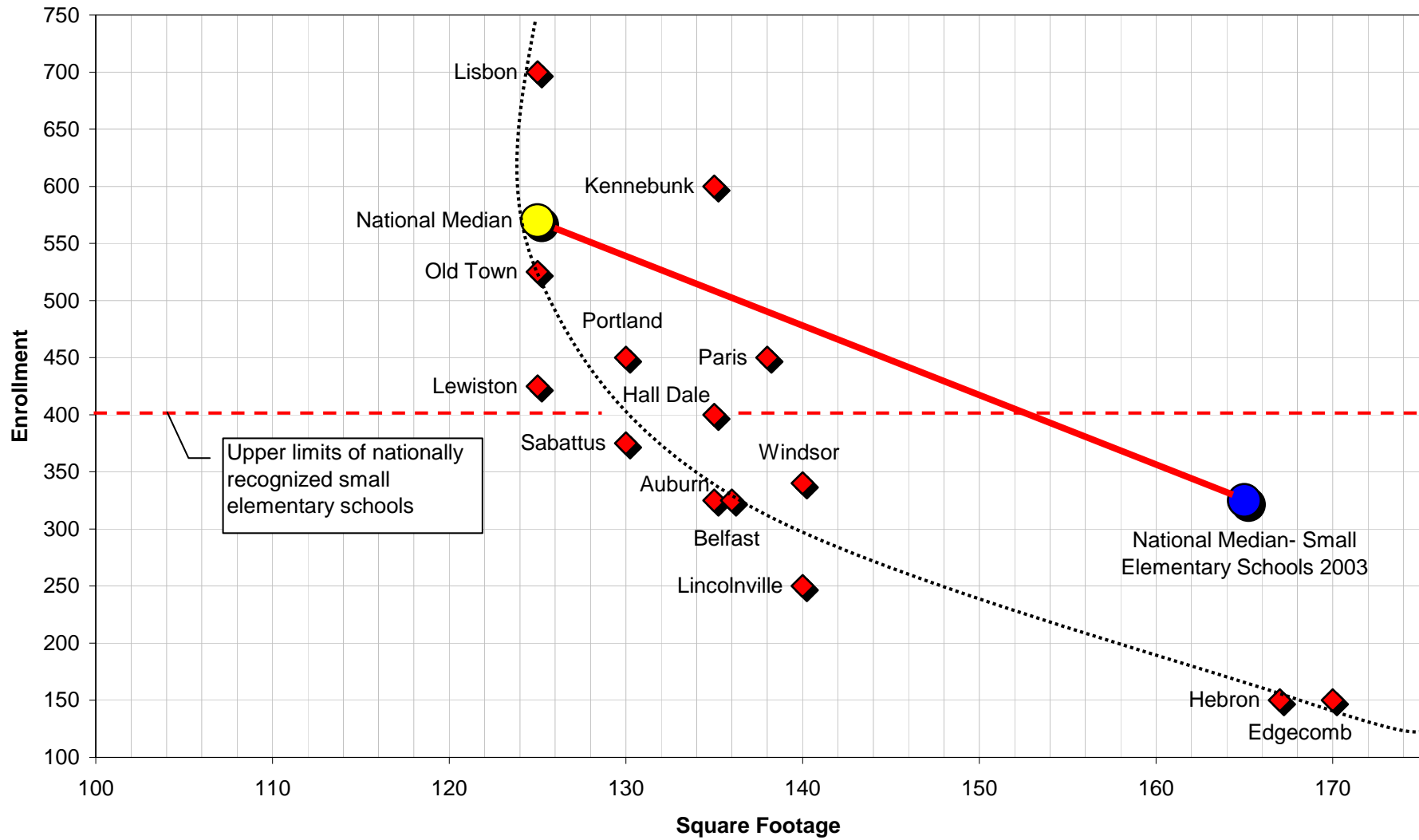
The national information shows that in all three levels smaller schools use more square footage per pupil than larger schools, and the smaller the school the more dramatic the difference.

The Maine information also shows that smaller schools use more square footage than larger schools and that Maine's new schools in general use less square footage per student than their national counterparts. This is surprising because Maine builds smaller schools than the national average so one would assume that their square feet per student would be above national average; but it's not.

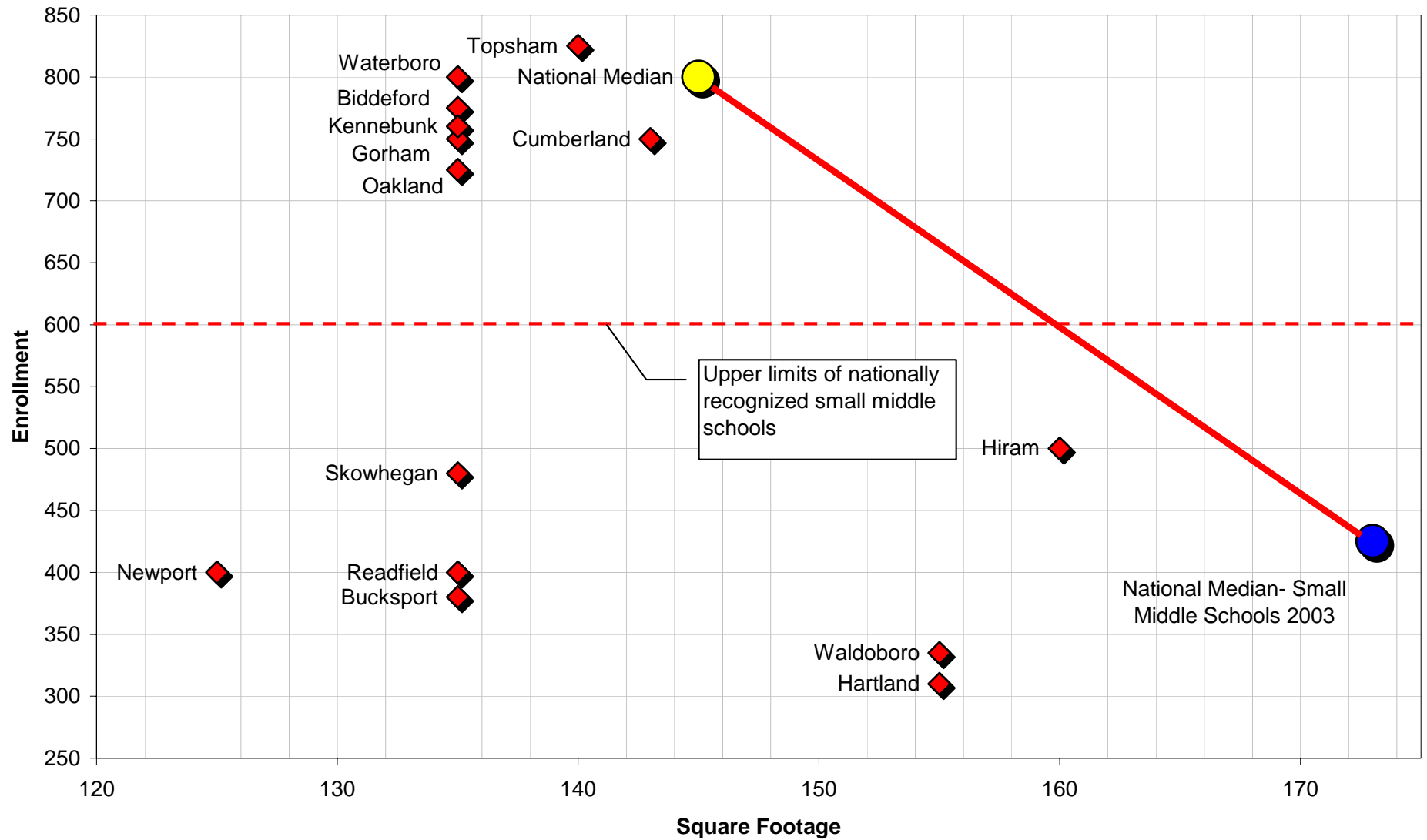
The high school chart is not as strong as the elementary and middle school charts because Maine has not built many high schools in the last few years, and therefore, does not have as much current data as the elementary and middle school charts.

The fourth chart entitled "Does School Size Matter?" identifies high, middle, and elementary schools and their size in terms of school population and square footage based upon national medians. This again reinforces the point that as school populations decrease, the square footage per student increases; thus the cost per student also increases.

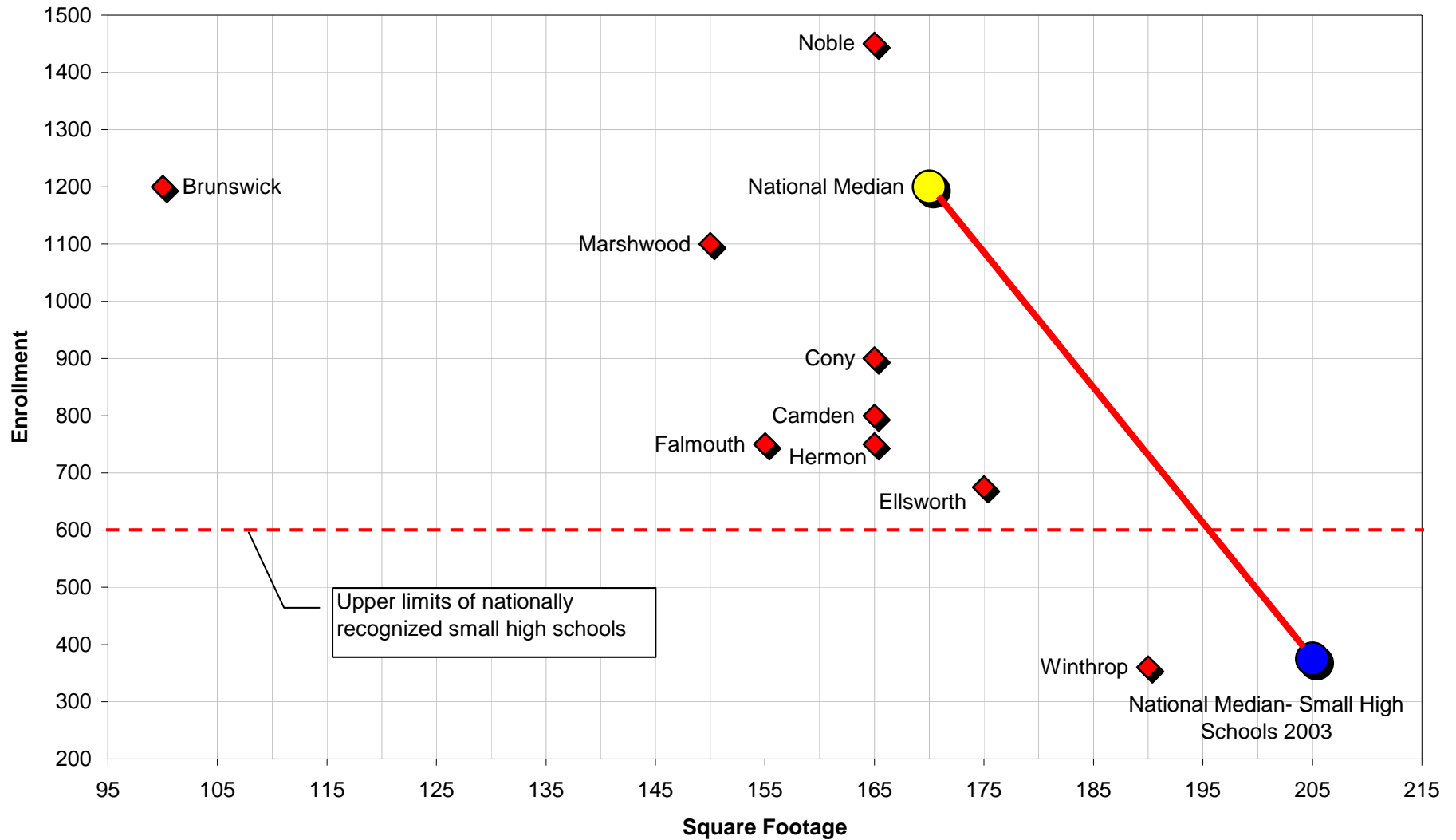
Elementary Enrollments & Square Footage New Construction 2000-2004



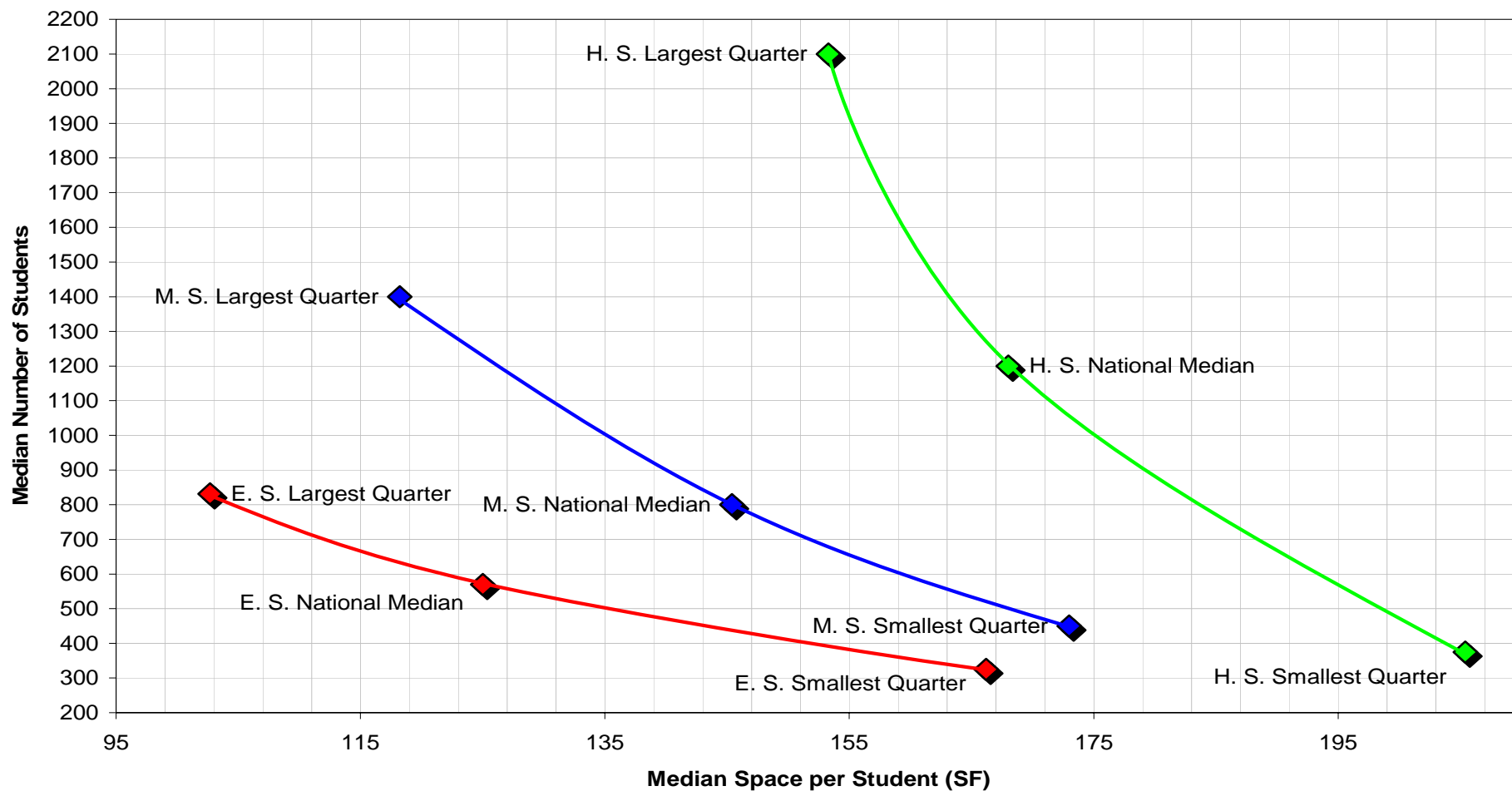
Middle School Enrollments & Square Footage New Construction 1999-2004



High School Enrollments & Square Footage New Construction 1996-2004



Does School Size Matter? National Analysis*



*Extracted from School Planning and Management, February 2004

